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Effect of 16 Percent Protein Starter Diets on Subsequent Performance of Growing and Laying Single-Comb White Leghorn Pullets

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INTRODUCTION

Studies dealing with means of reducing cost of feed for poultry are especially important to the economy of Hawaii, where feed dealers are almost completely dependent on imports of feed ingredients as well as mixed feeds to meet the needs of the poultry industry. This study was conducted to determine the feasibility of starting pullets with 16 percent protein diets instead of the conventional 20 percent protein recommended by the National Research Council (1971). Another objective was to study the effect of the low-protein starter diet on subsequent efficiency of egg production.

Carver et al. (1931) reported that 18 percent protein in the diet for the first 6 weeks of age was the most efficient and the rate of growth of chicks was satisfactory. St. John et al. (1933) found that the level of protein in the diet prior to 10 weeks had little influence on the efficiency of protein utilization by White Leghorn pullets after that age. Carver et al. (1939) observed that White Leghorn pullets fed 17 percent protein from 1 day to 6 weeks maintained as satisfactory growth as those fed the higher protein levels. Petersen and Sauter (1967) found that the protein level in the starter diet did not affect age at first egg, age at 50 percent egg production, egg weight, or annual egg production.

EXPERIMENTAL PROCEDURE

One hundred eighty Single-Comb White Leghorn (H & N) 1-day-old pullet chicks were randomly divided into 12 groups of 15 birds each. Three replicate groups were assigned to each of four treatments. Treatment 1 pullets were fed 16 percent protein starter-grower (302) and layer (110) diets containing a low-energy concentration (2872 kilocalories of metabolizable energy per kilogram).* Treatment 2 pullets were fed 16 percent protein starter-grower (303) and layer (111) diets containing a high-energy concentration (3096 kcal ME/kg). Pullets in treatments 3 and 4 were fed the same 20 percent protein starter diet containing the lower energy concentration (305) from 1 day to 6 weeks of age. The birds in treatment 3 were fed 16 percent protein grower (302) and layer (110) diets containing the lower concentration of energy, whereas those in treatment 4 were also fed 16 percent protein grower (303) and layer (111) diets but containing the higher concentration of energy. Feed and water were provided ad libitum. The composition of diets is shown in Table 1. Feeding schedule and experimental design are shown in Table 2.

The pullets were brooded in electrically heated all-wire Oakes battery brooders from 1 day to 3 weeks, transferred to unheated all-wire intermediate grower batteries from 3 to 8 weeks, and then moved to all-wire 121.9 cm X 152.1 cm developer pens from 8 to 18 weeks of age. At 18 weeks, the birds were moved to the laying house. Each pullet occupied an all-wire 25.4 cm X 45.7 cm laying cage from 18 to 74 weeks of age.

Data were obtained on body weight, feed consumption, egg production, sexual maturity, and mortality. Statistical analyses were made according to Duncan's multiple range test (1955) and Kramer's modification of the multiple range test from group means of unequal frequency (1956).

RESULTS AND DISCUSSION

Body Weight Gain

Data obtained on the effect of starter and grower rations on subsequent body weight are shown in Table 3. Pullets fed the 16 percent protein starter-grower diet (treatment 1) gained significantly less weight from 0 to 6 weeks of age than those fed the 20 percent protein starter-grower diet. Pullets fed the low-energy starter-grower diet (2872 kcal

*Abbreviation for metabolizable energy = ME.

Table 1. Composition and analysis of diets

Ingredient	Starter-grower diet			Layer diet	
	302	303	305	110	111
	%	%	%	%	%
Alphacel	3.0	—	—	0.70	—
Tallow, prime	—	2.10	—	—	5.60
Corn, yellow	68.63	69.93	61.03	67.13	60.93
Soybean meal (44%)	21.30	20.90	31.90	22.10	23.40
Alfalfa meal (17%)	3.00	3.00	3.00	3.00	3.00
Defluorinated phosphate	3.00	3.00	3.00	3.00	3.00
Oyster shell	—	—	—	3.00	3.00
Salt	0.50	0.50	0.50	0.50	0.50
DL-Methionine	0.20	0.20	0.20	0.20	0.20
Premix[1]	0.37	0.37	0.37	0.37	0.37
Total	100	100	100	100	100
Calculated analysis					
Protein, %	16	16	20	16	16
Calcium, %	1.15	1.15	1.15	2.28	2.28
Phosphorus, %	.84	.84	.89	.84	.83
ME/kg, kcal	2872	3096	2872	2872	3096
Energy:protein ratio	180	193	144	179	194

[1]Premix supplied the following per 100 grams of diet: vitamin A, 978 I.U.; vitamin D_3, 244 I.C.U.; vitamin E, 1.22 I.U.; riboflavin, 0.65 mcg; niacin, 3.02 mg; d-pantothenic acid, 1.04 mg; choline chloride, 32.62 mg; vitamin B_{12}, 1.63 mcg; folic acid, 40.8 mcg; menadione sodium bisulfite complex, 0.326 mg; B.H.T., 18.5 mg; manganese, 8.80 mg; zinc, 4.07 mg; iodine, 0.178 mg; iron, 2.96 mg; copper, 0.296 mg; cobalt, 29.6 mcg.

Table 2. Experimental design and feeding schedule

Factor	Treatment			
	1	2	3	4
Replicate/treatment	3	3	3	3
Birds/replicate	15	15	15	15
Starter protein, %	16	16	20	20
Test diets[1]				
Starter (0–6 weeks)	302 (L)	303 (H)	305 (L)	305 (L)
Grower (6–18 weeks)	302 (L)	303 (H)	302 (L)	303 (H)
Layer (18–74 weeks)	110 (L)	111 (H)	110 (L)	111 (H)

[1](L) = 2172 kcal ME/kg; (H) = 3096 kcal ME/kg.

Table 3. Effect of starter and grower diets on subsequent body weight gain and feed consumption of pullets[1]

Factor	Treatment			
	1	2	3	4
Starter protein, %	16	16	20	20
Energy[2]				
Starter	Low	High	Low	Low
Grower	Low	High	Low	High
Layer	Low	High	Low	High
Body weight gain, grams				
0–6 weeks	390.7[b]	366.8[a]	426.9[c]	436.4[c]
6–18 weeks	950.2[a]	903.7[a]	892.8[a]	893.0[a]
18–74 weeks	434.1[a]	541.1[b]	410.6[a]	546.9[b]
Feed consumption, gram/bird				
0–6 weeks	1,049[b]	956[a]	1,059[b]	1,058[b]
6–18 weeks	4,873[a]	4,566[a]	4,458[a]	4,640[a]
18–24 weeks	3,414[a]	3,190[a]	3,440[a]	3,275[a]
24–74 weeks	36,039[b]	33,392[a]	36,176[b]	33,867[a]

[1]Means on the same horizontal line bearing different superscripts are significantly different ($P < 0.05$).

[2]Low = 2872 kcal ME/kg; High = 3096 kcal ME/kg.

ME/kg, treatment 1) with low-energy protein gained significantly more weight than those fed the higher energy starter-grower diet (3096 kcal ME/kg, treatment 2) with low protein, suggesting that there may be an optimum energy to protein ratio at a given protein level for optimum growth during the starting period.

Energy and protein levels in the starter diet did not significantly affect weight gain from 6 to 18 weeks of age. However, dietary energy significantly affected weight gain from 18 to 74 weeks. Pullets fed the lower energy diet (treatment 1) gained significantly less weight than those fed the higher energy diet (treatment 2). Protein content of the starter diet did not significantly affect weight gain from 6 to 18 or 18 to 74 weeks of age (treatments 1 and 3).

Feed Consumption

Treatment significantly affected feed consumption from 0 to 6 and 18 to 74 weeks but not from 6 to 18 weeks of age. During the starting period, birds fed the lower energy diet (treatment 1) consumed significantly more feed than those fed the higher energy diet (treatment 2). This may partly explain why the birds in treatment 2 gained significantly

less weight than those in treatment 1 during the first 6 weeks of age. The diets fed in treatments 1 and 2 contained the same concentration of protein but the energy levels were different. Pullets fed the higher energy diet (treatment 2) consumed less feed, hence less protein daily, to meet their amino acid requirement. As a consequence, their protein intake may not have been sufficient to meet their requirement for optimum growth. Those fed the lower energy diet consumed more feed and hence more protein daily, thus consuming sufficient protein for greater growth.

Protein concentration in the starter diet did not significantly affect feed consumption during the laying period (treatments 1 and 3). However, dietary energy level significantly affected feed consumption (treatment 1 vs. treatment 2; treatment 3 vs. treatment 4). Pullets fed the higher energy diets consumed significantly less feed than those fed the lower energy diets during the 24 to 74 weeks' laying period.

It was concluded from the preceding data that 16 percent protein starter diets containing 2872 kcal ME/kg may be used for starting 1-day-old Single-Comb White Leghorn pullet chicks without significantly affecting feed consumption during the growing and laying periods.

Mortality

A comparison of the subsequent mortality of birds fed 16 and 20 percent protein starter rations revealed no significant differences in losses from all causes from 0 to 6, 6 to 18, and 18 to 74 weeks of age due to treatment (Table 4). The highest mortality was observed during the laying period. Most of the mortality was due to leucosis (visceral form). Death due to leucosis occurred as early as the 23rd week of age. Although pullets used in this study were the first group of layers housed in a new laying house in a new location, mortality was high. Dietary energy concentration did not significantly affect mortality.

Protein concentration in the starter ration did not significantly affect mortality during the starting, growing, or laying periods (treatments 1 and 3).

Sexual Maturity

Protein and energy concentration in the starter diet did not significantly affect sexual maturity (Table 4). Pullets in treatments 1 and 3 were fed 16 and 20 percent protein starter diets, whereas those in treatments 1 and 2 were fed 2872 and 3096 kcal ME/kg starter diets, respectively. Average age at 50 percent egg production differed only 1.8 days. The difference was not significant.

Table 4. Effect of starter and grower diets on subsequent mortality, egg production, and efficiency of egg production of pullets

Factor	Treatment			
	1	2	3	4
Starter protein, %	16	16	20	20
Energy[1]				
Starter	Low	High	Low	Low
Grower	Low	High	Low	High
Layer	Low	High	Low	High
Mortality, %[2]				
0–6 weeks	0	0	0	0
6–18 weeks	2.38	2.56	0	4.44
18–74 weeks	23.80	16.61	28.85	24.17
Age at 50% production, days	164.8	164.3	163.0	163.33
Hen-day production, 24–74 weeks, %	62.5	63.8	63.2	65.9
Feed per egg, grams[3]	165.0[b]	148.0[a]	165.2[b]	147.0[a]

[1] Low = 2872 kcal ME/kg; High = 3096 kcal ME/kg.

[2] Based on number of pullets. Sexed pullets contained cockerels, which were taken out at 3 weeks.

[3] Means on the same horizontal line bearing different superscripts are significantly different ($P < 0.05$).

Hen-Day Egg Production

A comparison of hen-day egg production from 24 to 74 weeks of age showed that dietary protein level in the starter diet did not significantly affect the number of eggs produced (treatments 1 and 3). Likewise, dietary energy level in the starter, grower, and layer diets did not significantly affect hen-day egg production. Pullets in treatments 1 and 2 were fed low- and high-energy diets, respectively, during the starting, growing, and laying periods, but did not differ significantly in the number of eggs produced. Pullets that were fed the same 20 percent protein starter diets but low- and high-energy grower and layer diets did not differ significantly in hen-day egg production (treatments 3 and 4). However, birds fed the higher energy grower and layer diets (treatment 4) produced 2.7 percent more eggs than those fed the lower energy grower and layer diets (treatment 3).

Feed Conversion

Pullets fed the low-energy diets consistently consumed more feed per egg produced. Treatment 1 pullets, which were fed the lower energy starter, grower, and layer diets, consumed 17.0 grams more feed per egg than those in treatment 2, which were fed the higher energy diets. Likewise, the treatment 3 pullets, which were fed the lower energy grower and layer diets, consumed 18.2 grams more feed per egg than those in treatment 4, which were fed the higher energy grower and layer diets. Also, pullets fed the low-energy diets consumed more energy per egg than those fed the higher energy diets.

Protein concentration in the starter diet did not significantly affect the number of eggs produced per unit of feed. Treatments 1 and 3 pullets were fed 16 and 20 percent protein starter diets but their feed conversions were similar, 165.0 and 165.2 grams of feed per egg produced, respectively. Pullets fed the higher energy diets consistently consumed less feed per egg. This was true for pullets fed 16 percent protein starter diets (treatments 1 and 2) and those fed 20 percent protein starter diets (treatments 3 and 4).

The preceding observations suggest that the level of energy in the laying diet is probably more critical than in the starting diet for overall egg production efficiency. The data also showed that 16 percent protein starter diets may be used for 1-day-old egg-type pullet chicks without significantly affecting their subsequent overall efficiency during the growing and laying periods.

SUMMARY

One hundred eighty Single-Comb White Leghorn day-old pullets were used to study the effect of 16 percent protein starter diets on subsequent body weight, feed consumption, mortality, egg production, and feed efficiency.

Pullets fed 16 and 20 percent protein starter diets containing 2872 kcal ME/kg did not differ significantly in weight gain from 6 to 74 weeks of age, feed consumption, mortality, age at 50 percent egg production, hen-day egg production, and feed per egg produced. Those fed 16 percent protein starter, grower, and layer diets containing 2872 and 3096 kcal ME/kg differed significantly in weight gain and feed consumption during the laying period. Birds fed the high-energy diets gained significantly more weight and consumed significantly less feed than those fed the lower energy diets during the 50-week egg production test period.

Sixteen and 20 percent protein and 2872 and 3096 kcal ME/kg starter diets did not significantly affect pullet mortality, age at 50 percent egg production, or hen-day egg production.

Pullets fed the lower energy grower and layer diets consistently consumed more feed per egg produced than those fed the higher energy grower and layer diets.

It was concluded that Single-Comb White Leghorn day-old pullets may be fed 16 percent protein starter diets without significantly affecting overall egg production efficiency.

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